Soils and Land Use Learning Objectives for the NCF-Envirothon

You may not pay much attention to it, but there is a lot going on underneath your feet! Soil is the foundation for all terrestrial life. Soil shapes our landscape. It nourishes plants – growing crops, grasses, and forests to form the basis of our food webs. It serves as a natural purifier for water, filtering out toxins and pollutants. It helps to recycle nutrients and provides habitat for fungi, microbes, and fossorial animals. The health of the soil is essential to the health of terrestrial ecosystems and to our way of life.

Just like the ecosystems we study, human society and culture are incredibly diverse. In the same way that biodiversity makes ecosystems more resilient, these differences in human perspective and experience make us stronger as a global community. Every person's story and relationship with the environment is important, and we must work together to ensure that everyone's stories are heard, including the historically marginalized and economically disadvantaged. We invite you to seek out stories from your own communities – to discover the unsung conservation heroes, to learn the histories that aren't typically taught in classrooms, to highlight local environmental issues, and to explore what types of natural resource conservation are occurring in your local community, state/province, and nation.

Students should be able to:

- Provide an informed opinion about current issues in soil conservation.
- Think critically about the role of soil in climate adaptations.
- Link soil knowledge to the broader topic of climate change
- Work collaboratively in a team to synthesize and apply knowledge.
- Make connections between the concepts in Soils and Land Use and the subjects of Forestry, Aquatic Ecology, Wildlife, and the Current Issue.

Students will be able to:

Geology

1. Explain the impact of geomorphology on landforms and landscapes, and how these processes relate to soil formation.
2. Identify unique geological features of the state/province, nation, and world.
3. Describe the role of tectonic plate movement to create landforms and geologic events (such as earthquakes and volcanic eruptions) and how it impacts soil formation.
6. Describe how the rock type of a parent material determines what minerals are present in a soil.
7. Explain the importance of different types of weathering (mechanical and chemical) in soil formation.
8. Describe how geology influences topography, on both micro and macro scales.

"Geology" Resources:

- Glossary of Geologic Features/Terms: https://portal.ct.gov/DEEP/Geology/Glossary-of-Geologic-FeaturesTerms
- Geologic Map of NH: https://dec.vermont.gov/sites/dec/files/geo/images/NH1997Map.pdf
- Plate Tectonics and Landforms: https://oceanexplorer.noaa.gov/facts/tectonic-features.html
- Igneous, Sedimentary, and Metamorphic Rock Information: https://www.amnh.org/explore/ology/earth/if-rocks-could-talk2/three-types-of-rock#:~:text=Igneous%20rocks%20are%20formed%20from,by%20heat%20and%20pressure%20underground. and https://education.nationalgeographic.org/resource/rock-cycle/
- Earth's Crust: https://education.nationalgeographic.org/resource/crust/
- Rocks and Parent Material: https://landscape.soilweb.ca/parent-material/ and https://www.ctahr.hawaii.edu/mauisoil/a_factor_form.aspx#:~:text=There%20are%20two%20general%20rules,to%20yield%20more%20fertile%20soils.

*neither of these links are specific to NH but provide some good overall info about the formation of different parent materials

- Rock Weathering: https://education.nationalgeographic.org/resource/weathering/

Soil Structure and Function

9. Define the five soil-forming factors and describe their influence on a particular soil.
10. Identify different types of parent material and how they are formed (such as residual material, eolian deposits, alluvial and marine deposits, colluvial deposits, volcanic deposits, glacial deposits, and organic deposits).

13. Describe how different soil components (mineral composition, organic matter, particle size, et cetera) affect the properties of a soil.

14 Connect a variety of soil processes to observed soil characteristics. (For example, the incorporation of organic matter resulting in darker topsoil and improved soil structure.)

16. Describe the importance of organic matter in various forms (humus, litter, et cetera) to soil health, structure, and fertility.

17. Identify the different particle sizes in a soil (sand, silt, and clay) and describe how their proportions influence soil properties.

22. Describe what factors influence available water capacity in a soil, and how this affects vegetation growth.

23. Explain the requirements for a Prime Farmland designation and identify potential candidates.

25. Identify characteristics and properties of hydric soils.

"Soil Structure and Function" Resources

- Five Soil Forming Factors: https://rangelandsgateway.org/topics/rangeland-ecology/soil-forming-factors
- Different Parent Materials and their Formation: Rocks and Parent Material: https://landscape.soilweb.ca/parent-material/ and https://www.ctahr.hawaii.edu/mauisoil/a_factor_form.aspx#:~:text=There%20are%20two%20general%20rules,to%20yield%20more%20fertile%20soils.

*neither of these links are specific to NH but provide some good overall info about the formation of different parent materials

- Soil Forming Processes: https://passel2.unl.edu/view/lesson/293965be23a0/2

*Bonus: this page has some practice quiz questions

- Physical Properties of Soils: https://ag.umass.edu/vegetable/fact-sheets/soil-basics-part-i-physical-properites-of-soil#:~:text=Sandy%20soils%20have%20rather%20large,pore%20space%20than%20sandy%20soils. and https://extension.umaine.edu/gardening/manual/soils/soil-and-plant-nutrition/
- Role of Organic Matter: https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/soil-health/role-of-organic-matter
- Prime Farmland: https://efotg.sc.egov.usda.gov/references/public/CO/5a_Prime_Farmland_Definition.pdf
- Hydric Soils: https://floridadep.gov/water/submerged-lands-environmental-resources-coordination/content/wetland-delineation-hydric-soils#:~:text=The%20USDA%20%2D%20NRCS%20recognizes%20four,gley%20colors%20and%20sulfidic%20odor.

Soil Ecology

26. Describe the cycles of essential elements (such as nitrogen, phosphorus, and carbon) as they relate to soil, nutrient availability, and plant growth.
27. Explain how plants take in nutrients and water, and what soil conditions and characteristics influence this uptake
29. Describe the ecosystem services provided by soil, such as water filtration, carbon sequestration, nutrient cycling, et cetera.

"Soil Ecology" Resources

- Videos explaining nutrient cycling (nitrogen, phosphorus, and carbon): https://www.youtube.com/watch?v=c76x5yEkK_c and https://www.youtube.com/watch?v=leHy-Y_8nRs
- Soil Biodiversity: https://www.sciencedirect.com/topics/earth-and-planetary-sciences/soil-biodiversity

Soils, Land Use, and Society

37. Describe how soils and their associated ecosystems can be impacted by pollution
38. Describe common agricultural/urban practices and their effects on soil health.
41. Explain how certain types of soil are better suited than others for specific human uses(mining, farming, septic tanks, etc.)

"Soils, Land Use, and Society" Resources

- Effects of Pollution on Soil: https://www.soils.org/about-soils/contaminants/
- Soil and Agriculture: https://www.nature.com/scitable/knowledge/library/soil-the-foundation-of-agriculture-84224268/#:~:text=Agriculture%20alters%20the%20natural%20cycling,soil%20amendments%20are%20typically%20required. and https://www.sare.org/publications/farming-with-soil-life/farming-practices-that-can-put-soil-health-at-risk/

Field Skills

45. Identify characteristics of a soil pit or soil sample, including horizons, color, structure, texture, and special features.
46. Measure slope using a clinometer or other field tool
48. Use a soil survey (online and paper copy) to assess soil properties and conditions, such as drainage class and limitations on selected uses.
49. Use a soil triangle to evaluate the texture of a soil
51. Read and interpret a topographic map
56. Determine the drainage class for a particular soil
57. Evaluate a soil profile for soil properties and characteristics, land use history, water table level, and management recommendations.

Field Skills Resources

More soils information can be found at
https://www.nhenvirothon.org/_files/ugd/2c48e6_2b600441bf68487c983dc20c5b8b90eb.pdf

https://envirothon.org/the-competition/areas-of-study/soil-landuse/

For online soil maps can be found at

https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm?TARGET_APP=Web_Soil_Survey_application_2nb2uq1ozkolfzevkzjbts11

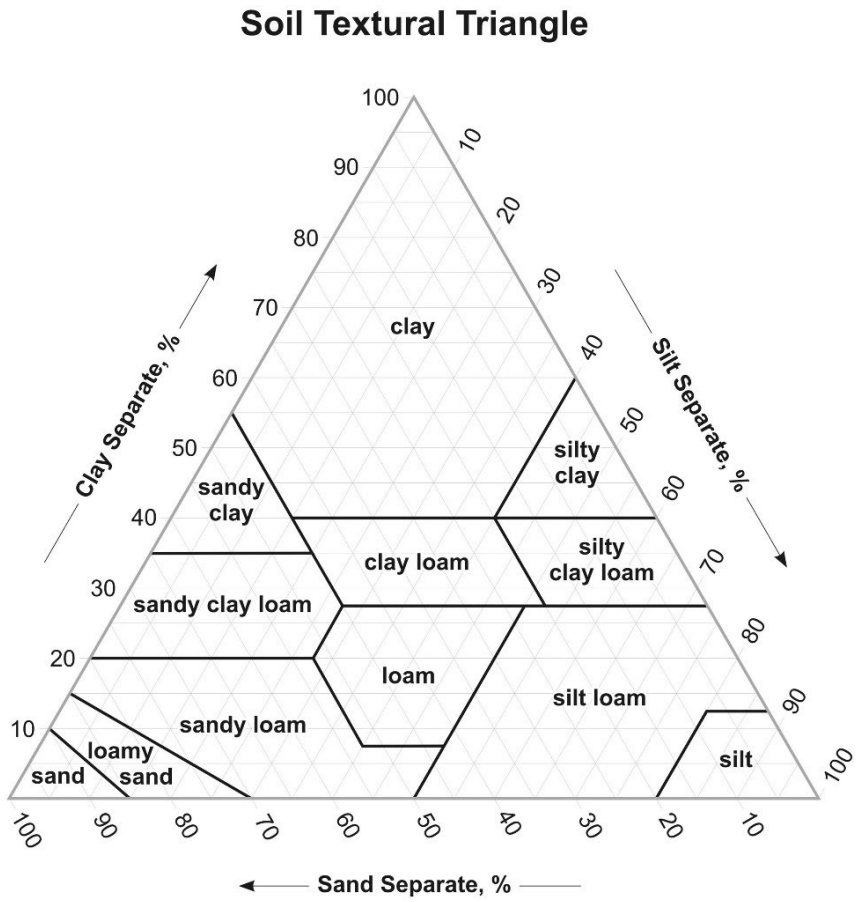

Figure 1. Soil Textural Triangle.

How can we determine texture in the field?

Soil scientists use the texture by feel method to texture soils in the field. There are also laboratory methods to determine soil texture, but these can be cost prohibitive and time consuming. A great method to determine soil texture can be found below.

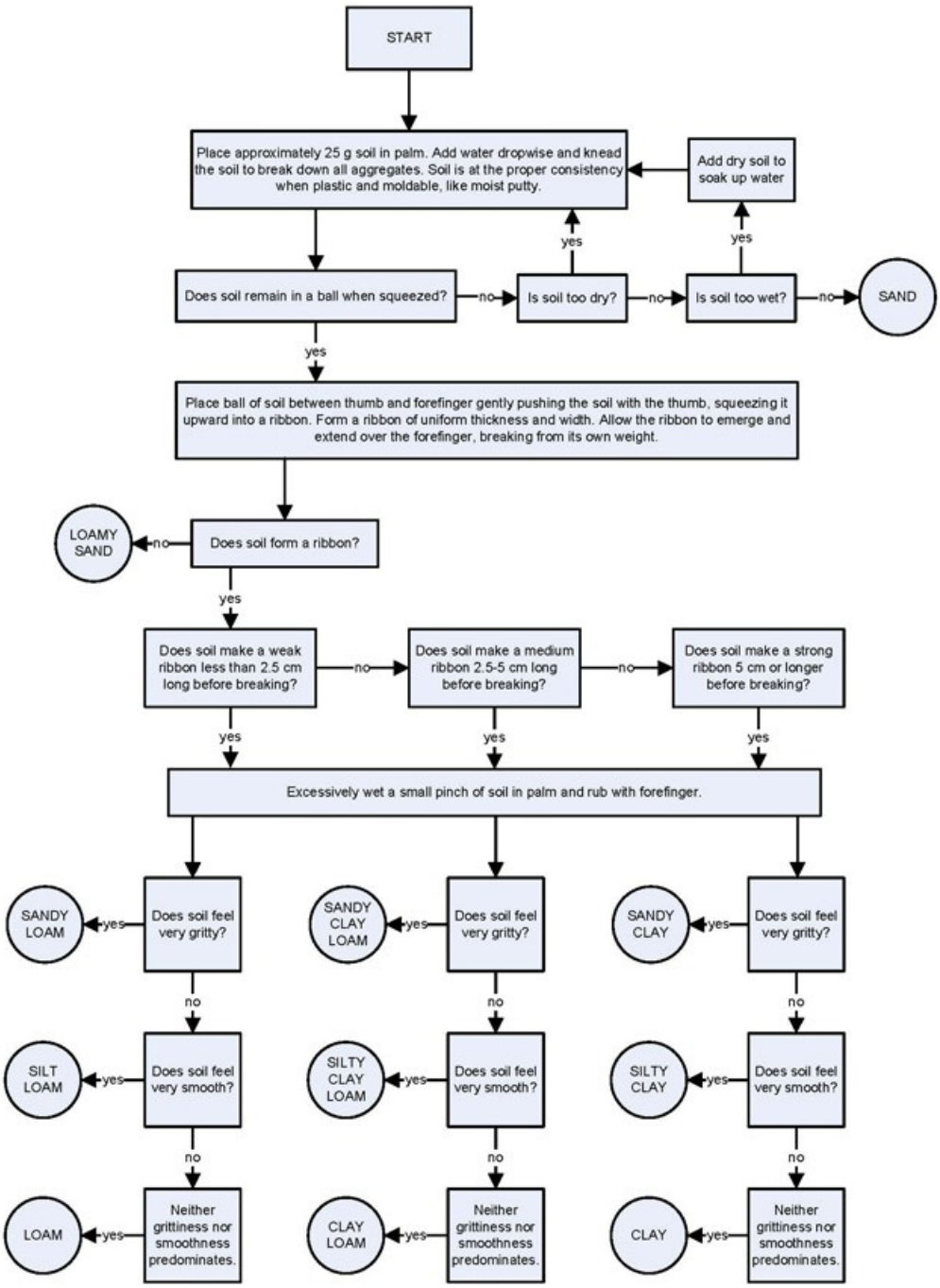

Figure 2. Texture by feel method.

Current Issue taken from NCF's Current Issue, Part A:

Key Topic #1: Non-Point Source Pollution Status (page 3)
How can changes in soil management practices impact NPS pollution? (adapted from key topic 1, number 2)

Key Topic #2: NPS in a Growing World and Your Role in It (page 46)
How do urban soils differ from forest soils in their contribution to runoff volume and pollutant loading? (adapted from key topic 2, number 2)

Key Topic #3: The Role of the Individual/Community in NPS Issues and Solutions (page 83)
What steps can individuals take to reduce the use of soil amendments that contribute to NPS pollution? (adapted from key topic 3, number 3)

Key Topic #4: Strategies to Evaluate NPS Sources, Issues, and Solutions (page 112)
Describe how site and soil physical features (e.g. slope, soil texture, impervious cover, soil depth) can be used to evaluate runoff and pollutant transport. (adapted from key topic 4, number 4)

Key Topic #5 Legislation, Regulations, and Voluntary Measures (page 146)
In what ways does protecting wetland soils through policies like the Clean Water Act help reduce NPS pollution? (adapted from key topic 5, number 3)

Key Topic #6: Your Best Management Practices for NPS (page 171)
Recommend appropriate BMPs for agricultural land with heavily compacted soil and excess soil phosphorous. (adapted from key topic 6, number 5)

"Current Event: Non-Point Source Pollution Mitigation" Resources

All learning objectives for the current event were taken from key topics in the Non-Point Source Pollution Mitigation - It Begins At Home study resources guide part A: https://envirothon.org/wp-content/uploads/2025/09/2026-Current-Issues-Part-A.pdf